

Claims

395 1. A reactor for anaerobic waste water treatment, comprising the following features:

(a) a central flow channel extending from the top in downward direction and terminating at the top with a first distance from the upper reactor confines and terminating at the bottom with a second distance from the lower reactor confines;

400 (b) in the annular space between the central flow channel and the reactor wall, there are positioned, either for the entire height of the flow channel or for part of the height of the flow channel, carrier elements for immobilizing microorganisms in the form of a structured, ordered fixed bed, with flow passages being provided between adjacent carrier elements;

405 (c) a lower portion of the reactor, between the lower confines thereof and the carrier elements, is in the form of a space intended to receive waste water with microorganisms floating therein during operation of the reactor;

410 (d) an upper portion of the reactor between the upper confines thereof and the carrier elements;

(e) the reactor, with respect to the internal flow thereof, is in the form of a loop-type column reactor such that waste water contained therein can be circulated through the central flow channel in downward direction, then through said space in the lower portion, then along the carrier elements in upward direction and finally again into the central flow channel;

415 (f) a supply line for waste water to be treated and to be introduced into the reactor for the first time;

420 (g) a discharge system for finally discharging treated waste water from the reactor.

2. A reactor according to claim 1,

425 characterized in that the space in the lower portion is intended to receive waste water having microorganism pellets floating therein.

3. A reactor according to claim 1 or 2,
characterized in that plate-shaped carrier elements are provided.

430 4. A reactor according to claim 3,
characterized in that a plurality of packages of carrier elements are distributed across the circumference of the reactor, with the plate-shaped carrier elements within each package being arranged parallel to each other and in tangential direction of the reactor.

435 5. A reactor according to any of claims 1 to 4,
characterized in that the flow passages between adjacent carrier elements have a width of 3 to 6 cm, preferably 3.5 to 5.5 cm.

440 6. A reactor according to any of claims 1 to 5,
characterized in that carrier elements porous to permit flow therethrough are provided.

445 7. A reactor according to any of claims 1 to 6,
characterized in that carrier elements are provided that consist substantially of plastics particles and expanded clay particles that are unified with each other.

450 8. A reactor according to any of claims 1 to 7,
characterized by a recirculation system comprising a withdrawal means for waste water and a supply means for flow delivery into the central flow channel.

455 9. A reactor according to any of claims 1 to 8,
characterized in that the withdrawal means comprises an intermediate space between two plate-like elements as well as a conduit starting in said intermediate space.

460 10. A reactor according to any of claims 8 to 9,
characterized in that the discharge system is positioned a distance above
the withdrawal means of the recirculation system.

465 11. A reactor according to any of claims 1 to 10,
characterized in that, in the upper portion of the reactor, below the
discharge system, there is provided a separator system serving to retain the
microorganisms floating in the waste water in the reactor.

12. A reactor according to claim 11,
470 characterized in that the separator system comprises a partition provided in
spaced apart manner above the upper end of the central flow channel and
covering a large part of the reactor cross-sectional area while leaving free
an outer annular area.

475 13. A reactor according to claim 12,
characterized in that the partition has portions in which it does not extend
horizontally and forms a gas collection space in a highest portion.

14. A reactor according to claim 13,
480 characterized in that, from the highest portion, the partition extends –
roughly speaking – outwardly in downwardly inclined manner downwards
and inwardly in downwardly inclined manner.

15. A reactor according to any of claims 12 to 14,
485 characterized in that the withdrawal means of the recirculation system is
positioned at the upper side of the partition.

16. A reactor according to any of claims 1 to 15,
characterized in that a first discharge line for gas formed in the reactor
490 starts in the upper portion of the reactor.

17. A reactor according to any of claims 1 to 16,

characterized in that in that a second discharge line for gas formed in the reactor starts in the region of the partition.

495

18. A reactor according to any of claims 1 to 17,
characterized in that carrier plates are positioned in 15 to 40 %, preferably
20 to 30 %, of the reactor volume.

500

19. A reactor according to any of claims 1 to 18,
characterized in that the lower portion of the reactor has a flow deflection
means positioned on the wall thereof.



505

20. A reactor according to any of claims 1 to 19,
characterized by at least one one driving jet outlet terminating below the
lower end of the central flow channel.

510

21. A reactor according to any of claims 1 to 20,
characterized in that it is designed such that different kinds of microor-
ganisms are provided as immobilized microorganisms on the one hand and
as floating microorganisms on the other hand.

22. A process for anaerobic waste water treatment in a reactor in which waste
water to be treated circulates, such that waste water

515

(a) flows centrally from above to below;

(b) then is in contact with microorganisms floating in the waste water in a
space in the lower portion of the reactor;

520

(c) then flows along microorganisms in a space of the reactor located
thereabove, the microorganisms being arranged on carrier elements in
the form of a structured, ordered fixed bed;

525

(d) and finally merges again into the central flow from above to below.

23. A process according to claim 22,

characterized in that, upon flowing past the microorganisms on the carrier elements, part of the waste water is branched off and pumped into the central flow channel.

530

24. A process according to any of claims 22 to 23,

characterized in that floating microorganism pellets are present in the treatment space.

535

25. A process according to any of claims 22 to 24,

characterized in that the microorganisms floating in the waste water are retained in the reactor by a separator system.

540

26. A process according to any of claims 20 to 25,

characterized in that different kinds of microorganisms are provided as immobilized microorganisms on the one hand and as floating microorganisms on the other hand.

545

27. The use of the reactor according to any of claims 1 to 21 or of the process

according to any of claims 22 to 26 for anaerobic waste water treatment of a plant of the beverage industry, the feeding stuff industry or the food processing industry.

550

28. The use of the reactor according to any of claims 1 to 21 or of the process

according to any of claims 22 to 26 for anaerobic waste water treatment of a plant of the paper industry or the textile industry.